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Photographic Guide
of Selected External Defect Indicators and Associated Internal Defects in Northern Red Oak

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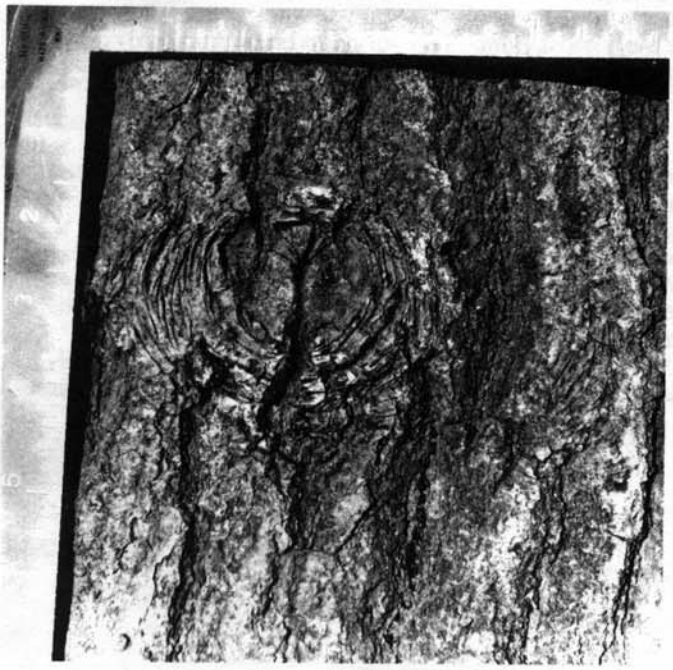

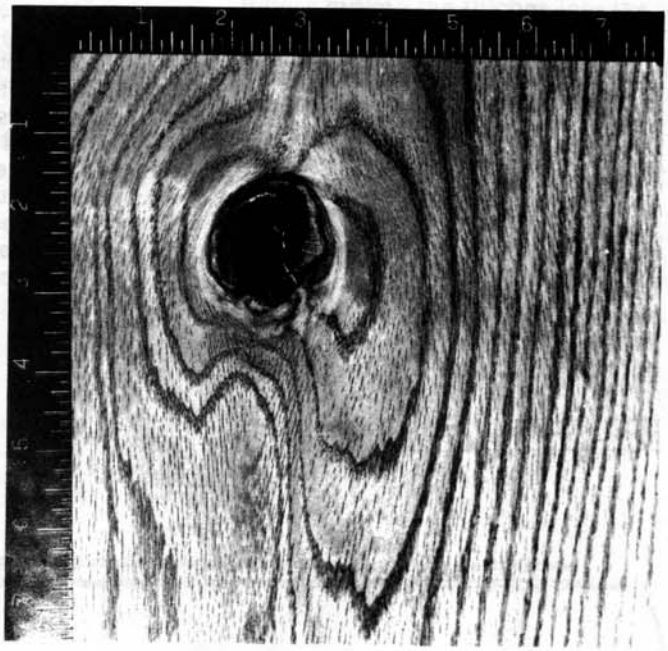

The Author

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Abstract

To properly classify or grade logs or trees, one must be able to correctly identify defect indicators and assess the effect of the underlying defect on possible end products. This guide aids the individual in identifying the surface defect indicator and also shows the progressive stages of the defect throughout its development. It illustrates and describes eight types of external defect indicators and associated defects that are particularly difficult to evaluate.

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Introduction

Hardwood tree- and log-grading systems are used to predict the volume and value of specified end products to determine the most valuable end use. To use the system, a basic knowledge of the relationships between exterior defect indicators and underlying defects is needed.

Many publications have been written on hardwood defect indicators, associated interior defects, and their effect on end products. Some of the publications have excellent photographs and descriptions of the defect indicators, but most have only one photograph of the defect as it appears in the interior of the log. However, Marden and Stayton (1970) and Frederick and co-workers (1973) working with sugar maple and black cherry, respectively, showed up to three views of the defects at various depths within the logs.

By conducting this study at a veneer slicing plant, I was able to trace the effect of a defect from its origin (or the backing board) to its terminus (or to the initial slice of veneer). Also by working with veneer, I was able to photograph changes in the defect characteristics as close together as 1/28 of an inch (one sheet of veneer), if desired. This study is the first in a series of pictorial guides by species or species groups.

Procedure

Twenty-five northern red oak logs exhibiting 46 selected defect indicators were selected from the log deck of a veneer plant in southwestern Pennsylvania. The following eight defect indicators appeared approximately five times each: adventitious buds; adventitious bud clusters; heavy, medium, and light distortions of knot overgrowths; overgrown wounds; bumps; and insect borer damage. These defects were selected because they are difficult to recognize on the surface of the log and their effect on the end product is difficult to evaluate.

The study logs were placed on stringers and washed using a medium-pressure water jet so the defect indicators could be photographed clearly. Lines were painted on the log ends to show where the log would be sawed for half-round slicing. Each log half was numbered to identify it throughout the veneering process. Defect indicators located in the center one-third (across the face) of the half-log were selected, identified, and their dimensions and distance from each end of the log were recorded. Log diameter and bark thickness were measured where each defect indicator occurred. The logs were then debarked and sawed into two flitches (Fig. 1). Before putting the flitches into the steam vats, an outline of both ends of each flitch was traced on a sketch pad. These outlines were used to determine wood loss between the bark and the initial slices of veneer. The length of the spurred-off veneer was measured on both ends of the flitches as they were sliced to aid in relocating and identifying the correct defect in the veneer by distance from the log ends.

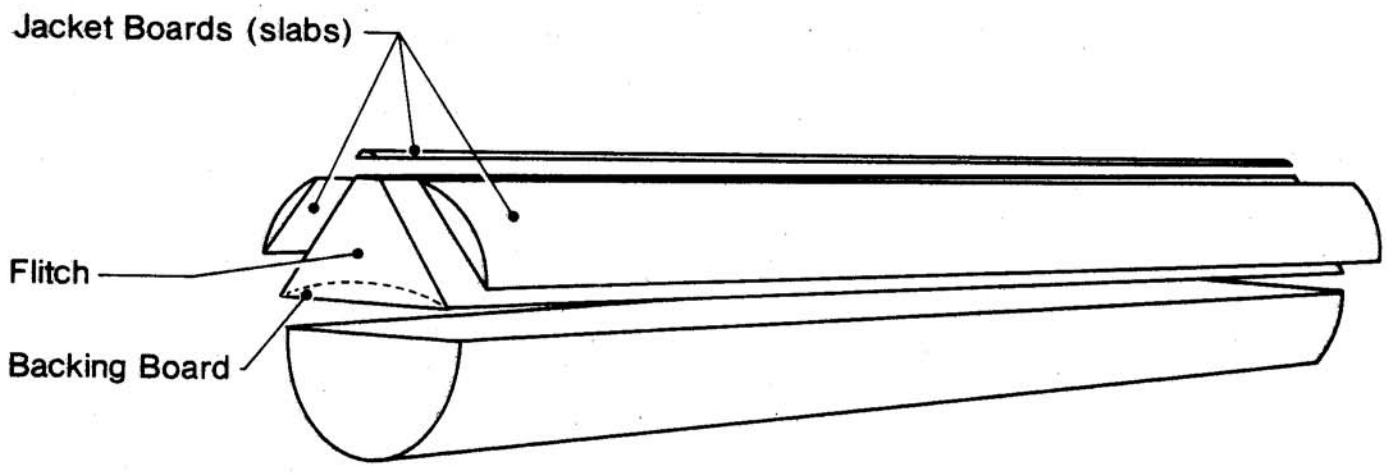


Figure 1.—A 2-flitch log showing sawing method and components.

After drying, black and white photographs of the defects were taken with a 2-1/4 x 2-1/4-inch single lens reflex camera. The individual defects in the veneer were correlated with the surface defect indicators by using the flitch number and location on the face of the veneer. The sheets of veneer were placed on a section of dead rolls to facilitate photographing several defects on a single sheet of veneer without moving the camera (Fig. 2). The first indication of the defect below the surface was photographed, and additional photographs were taken as the characteristics of the defect changed going down through the "book" of veneer. The photographs continued to the last sheet of veneer or until no indication of the defect remained.

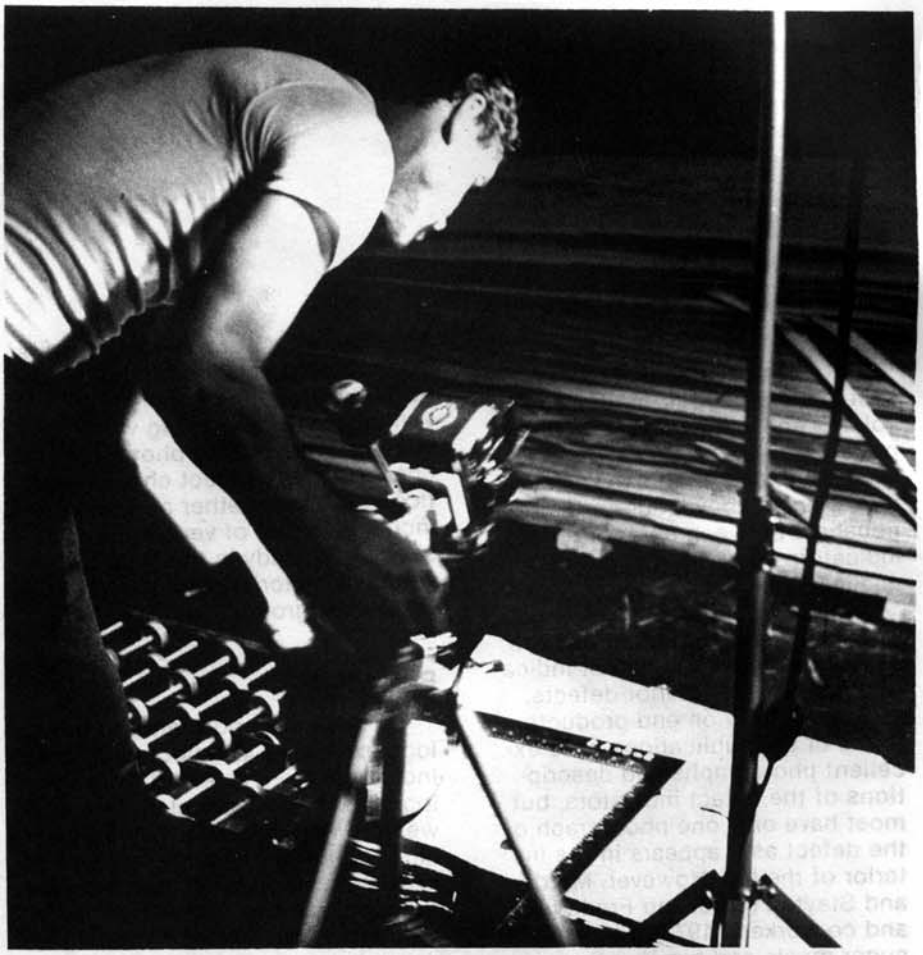


Figure 2.—Photography setup showing camera, dead rolls for moving veneer, and square used to outline and show defect size. Magnetic numbers were placed on square to correlate log and defect to each photograph.

Discussion of Defects

The defect indicators examined in this study are the most difficult to evaluate in terms of effect on end product quality. Graders normally have no difficulty recognizing the obvious grading defects such as bulges, burls, butt scars, forks, holes, seams, limbs, and so on. They do have difficulty with the eight types of defect indicators pictured in this guide.

Distortions of knot overgrowths are particularly difficult to assess and their correct identification is important since the amount of clear wood between the bark surface and the end of the overgrown dead limb stub directly affects the number of sheets of clear veneer that can be produced from a flitch.

Although this study involved 25 logs exhibiting 46 defect indicators, only one of each of the eight defect indicators and the underlying defects are pictured. Each of the defect indicators shown is representative of that type.

Descriptions below the surface indicators include defect size, which is the length (along the grain), width (across the grain), and height (above the normal bark surface) of the indicator; log diameter at the defect, which is diameter inside the bark; flitch thickness at the defect, which is the radial distance from the bark side of the flitch to the interior side of the backing board (Fig. 1); and log position. Depth below interior defects indicates distance below initial sheet of veneer. Accumulative veneer thickness is the distance from the initial slice of usable veneer to the top of the backing board.

Adventitious Buds

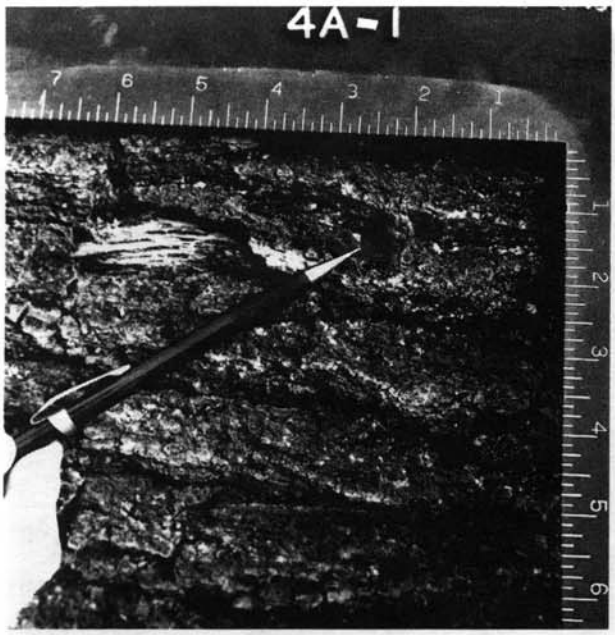
Figure 3 shows how the bud trace can persist for an indefinite number of years, yet not produce an epicormic branch even though the bud trace starts at a depth of more than 7 inches below the surface of the log. A bud trace in all hardwood species has a pith, though the pith may be very hard, if not impossible, to see with the naked eye (Esau 1960). In the wood surface, it normally appears as a grain distortion.

Adventitious Bud Clusters and Overgrown Epicormic Knots

Adventitious bud clusters and overgrown epicormic knots frequently are found together. When one epicormic branch forms, more adventitious buds tend to develop and form a cluster of short-lived fine limbs or twigs. Bark pockets commonly are associated with these defects.

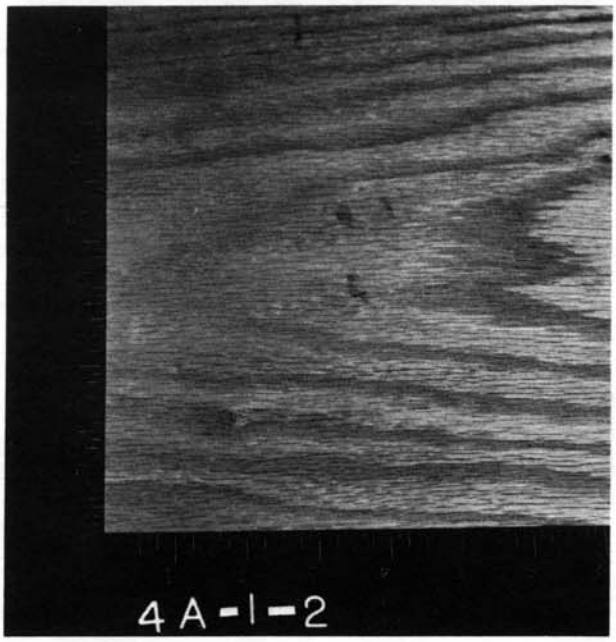
Figure 4 shows an adventitious bud that developed and sprouted into an epicormic branch. The branch died and a bark pocket formed. Other adventitious buds are also evident in figure 4.

Figure 3.—Adventitious bud and associated internal defects.

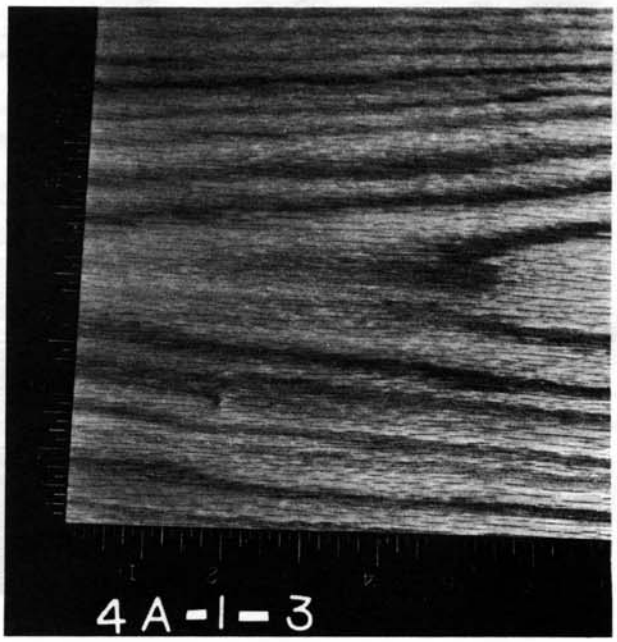


Defect size . . . . . 1/2 x 1/2 x 1/2 inch
Log diameter at defect . . . . . 20.0 inches
Flitch thickness at defect . . . . . 8.9 inches
Log position . . . . . butt log

Depth—0.3 inch

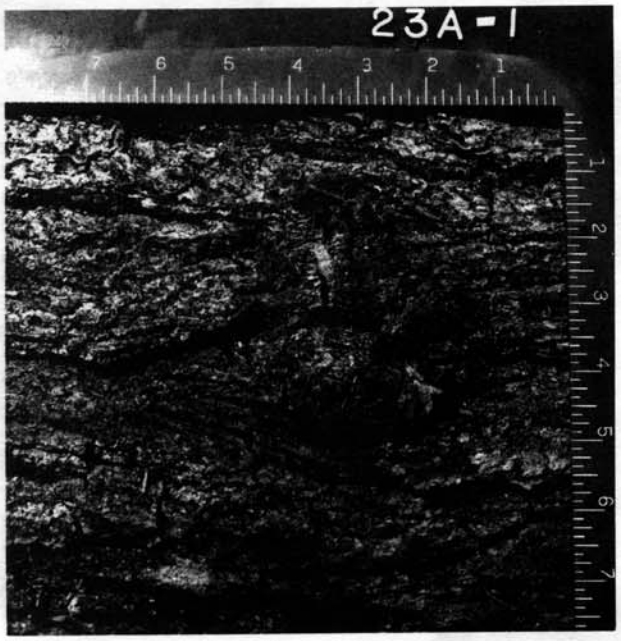


Depth—2.8 inches

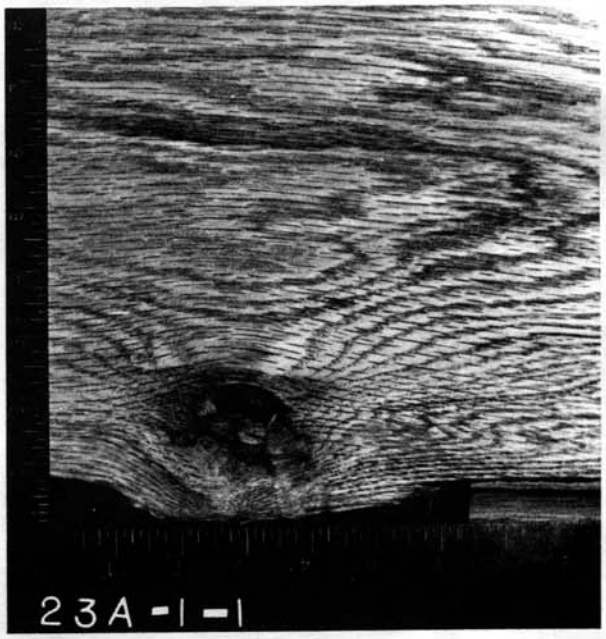


Depth—4.3 inches
Accumulative veneer thickness—5.6 inches

Figure 4.—Adventitious bud clusters, overgrown epicormic knot, and associated internal defects.



Defect size . . . . . 2 x 3 x 3/4 inches
Log diameter at defect . . . . . 16.9 inches
Flitch thickness at defect . . . . . 7.9 inches
Log position . . . . . upper log

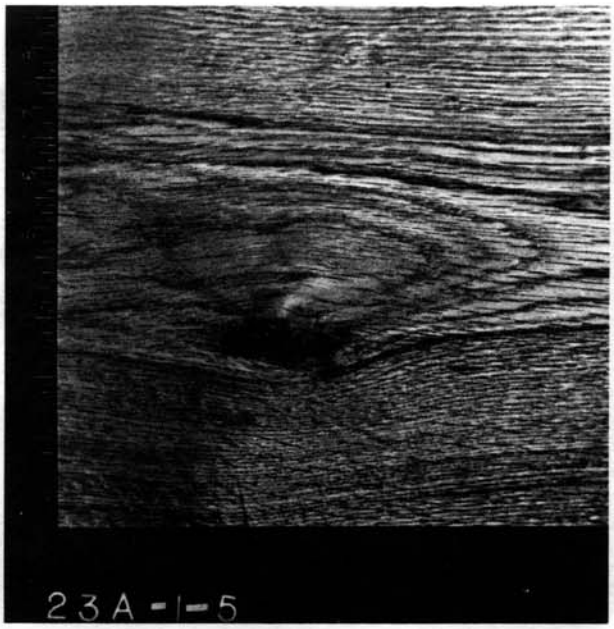


Depth—0.0 inch

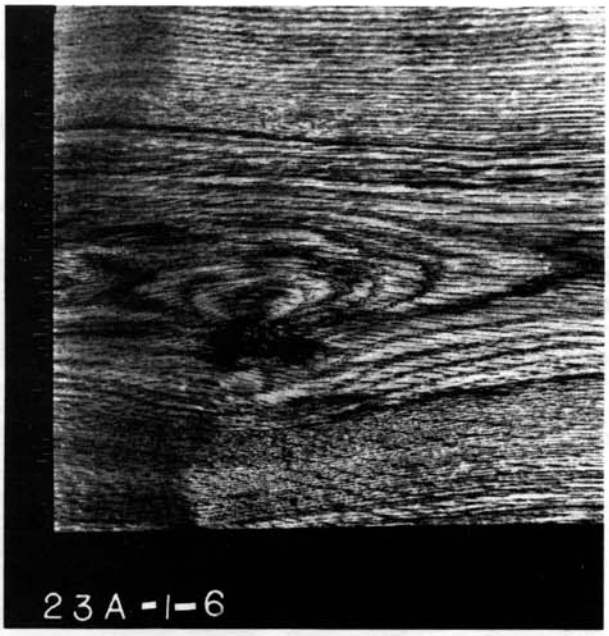
Depth—1.0 inch

Depth—2.0 inches

Depth—3.0 inches

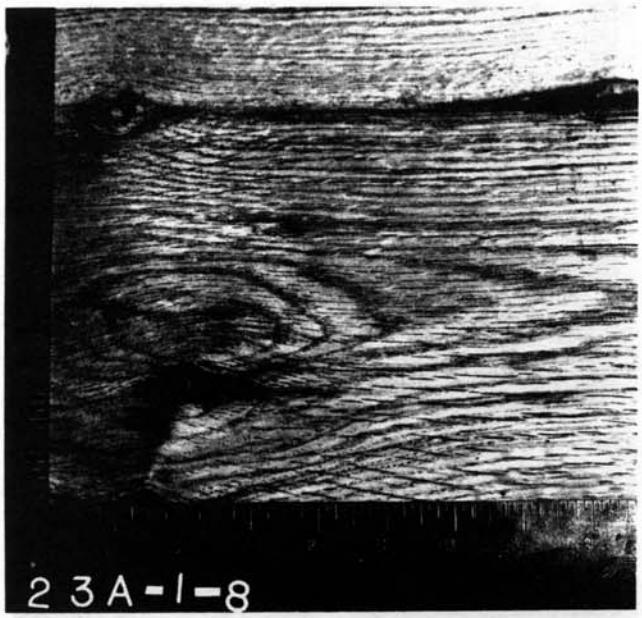


Depth—3.5 inches

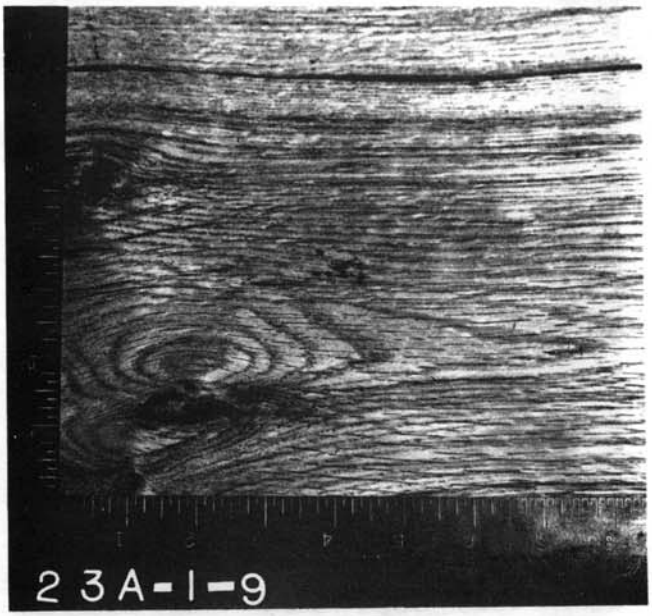


Depth—4.0 inches

Depth—4.5 inches



Depth—5.2 inches



Depth—5.7 inches
Accumulative
veneer thickness—5.7 inches

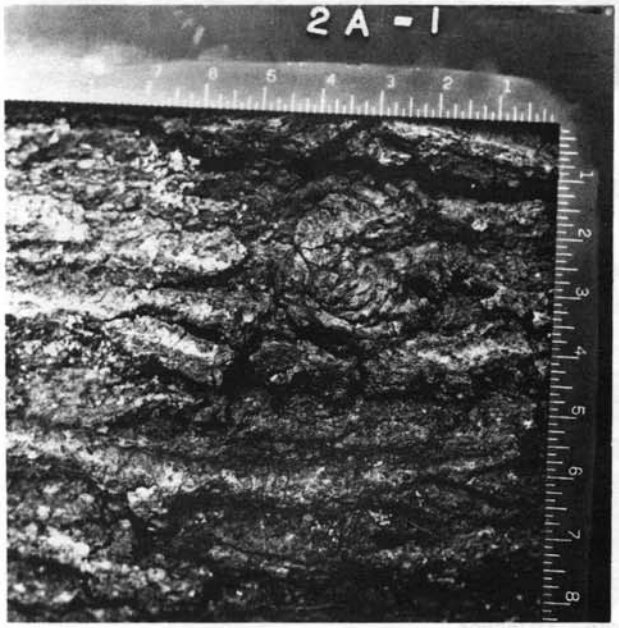
Knot Overgrowths

Knot overgrowths—those with no height measurements—are subdivided into three categories: heavy, medium, and light distortions. A heavy distortion (Fig. 5) will cause the most degrade or volume loss in the end product. It is identified by the characteristic pattern of concentric circles encompassing the defect indicator. Medium distortions (Fig. 6) show signs of the concentric circles, but the circles are broken in several areas by the normal bark pattern starting to reform. The light distortions (Fig. 7) show only a slight amount of curvature in the surrounding bark plates, and the bark pattern shows only slight variance from normal. Because the defect is deeply buried, the irregular bark patterns are almost inconspicuous and can be easily overlooked.

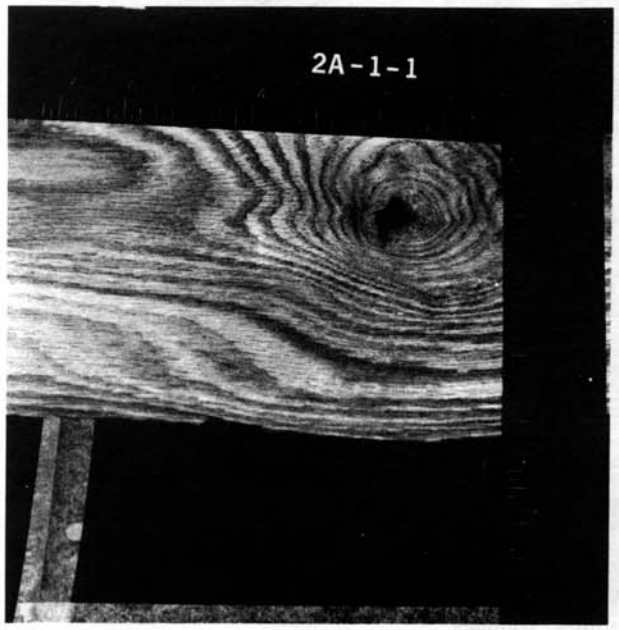
All the knot overgrowths will result in some product degrade, but the amount of degrade decreases as the depth of the initial defect below the log surface increases. This is substantiated by the examples. Because the three distortions (Fig. 5, 6, 7) are on logs of similar size, actual comparisons can be made. The number of slices of veneer before the actual defect appears is: heavy distortion—0, medium distortion—112, and light distortion—182.

Text continued on page 12

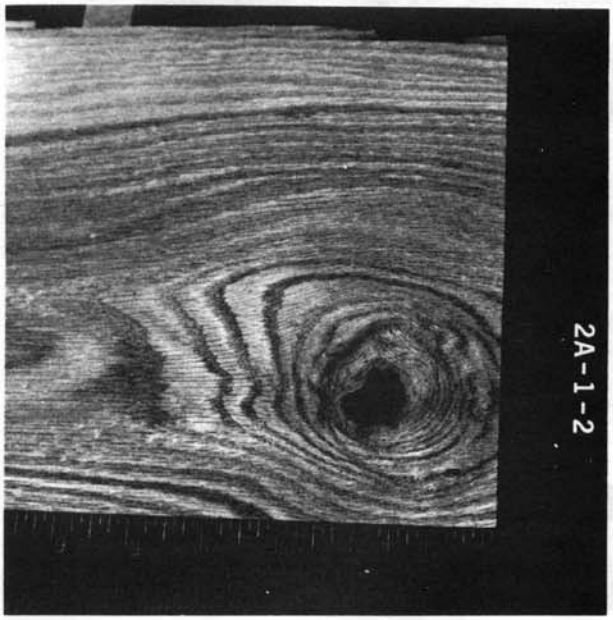
Figure 5.—Knot overgrowth (heavy distortion) and associated internal defects.



Defect size . . . . . 2 1/2 x 3 inches
Log diameter at defect . . . . . 20.3 inches
Flitch thickness at defect . . . . . 9.1 inches
Log position . . . . . upper log

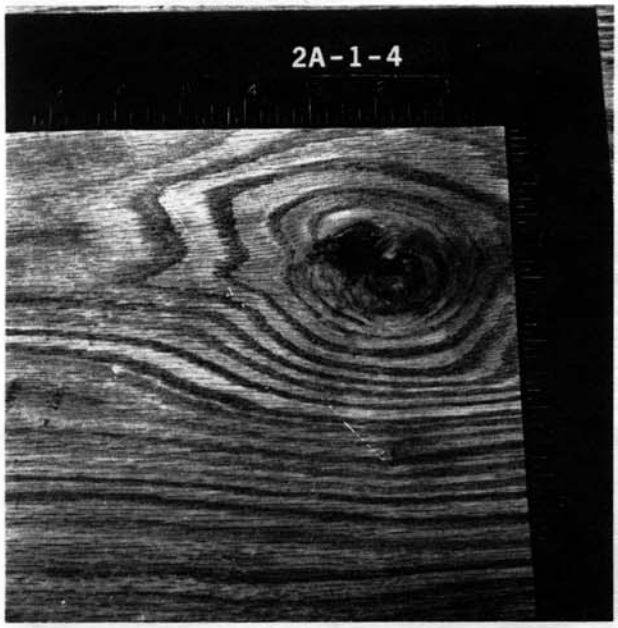


Depth—0.0 inch



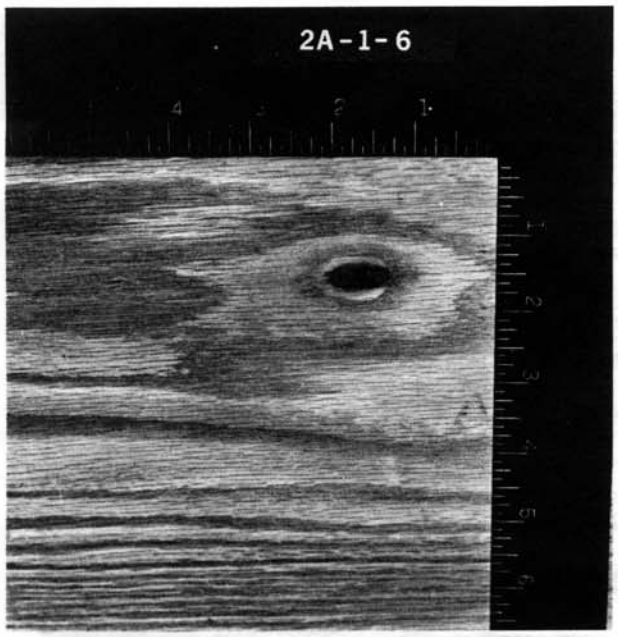
Depth—0.5 inch

Depth—1.0 inch

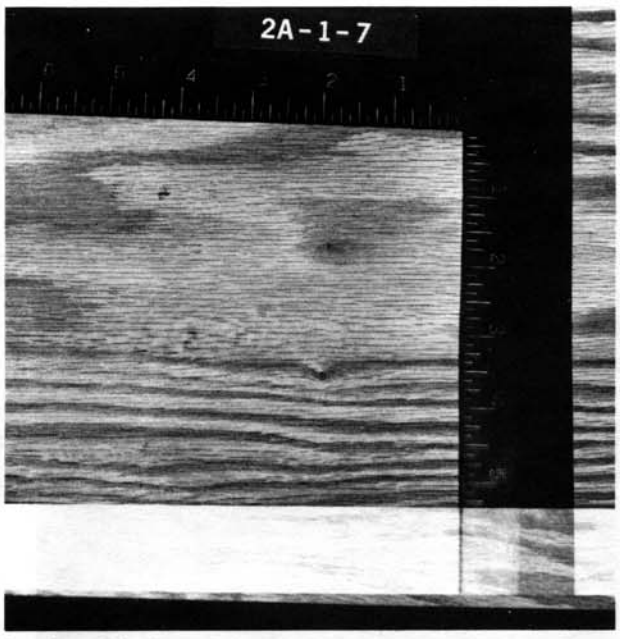


Depth—2.0 inches

Depth—3.0 inches

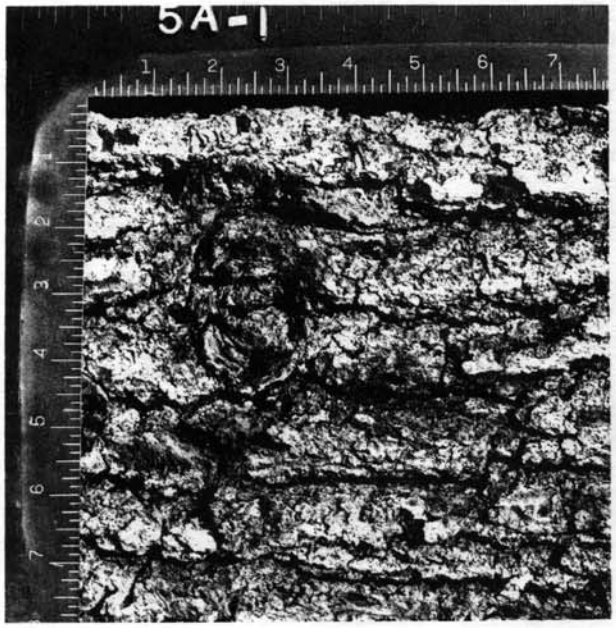


Depth—3.5 inches

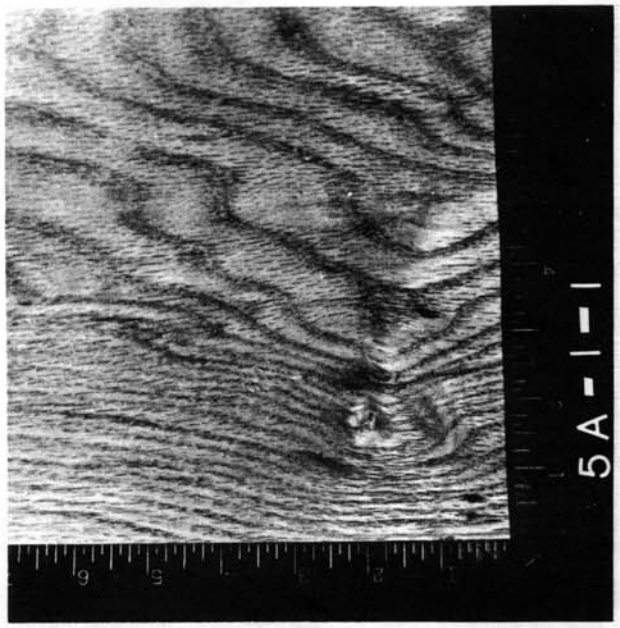


Depth—4.0 inches
Accumulative veneer
thickness—6.3 inches

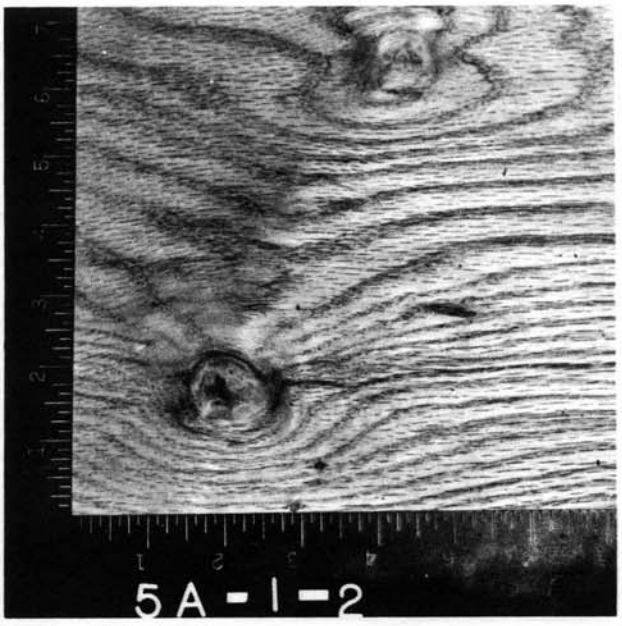
Figure 6.—Knot overgrowth (medium distortion) and associated internal defects.



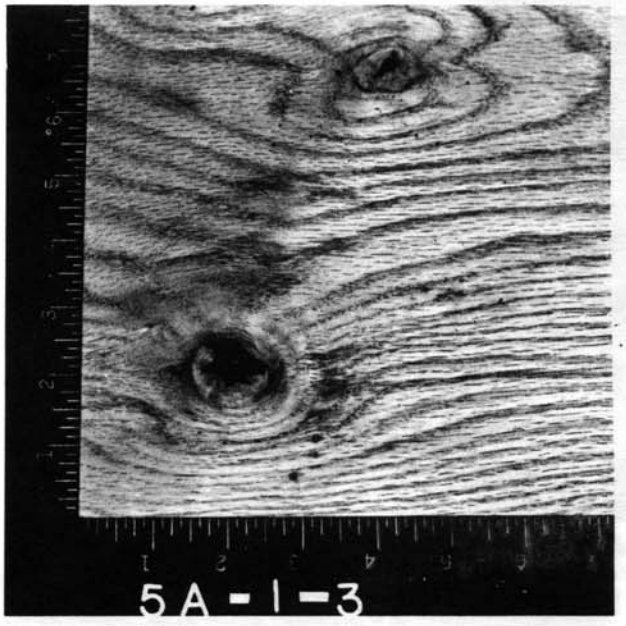
Defect size . . . . . 2 x 3 inches
Log diameter at defect . . . . . 22.8 inches
Flitch thickness at defect . . . . 10.1 inches
Log position . . . . . upper log



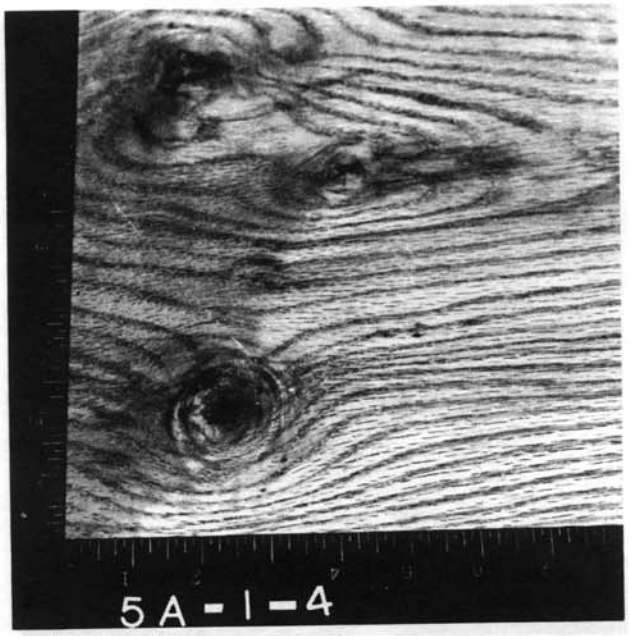
Depth—4.0 inches



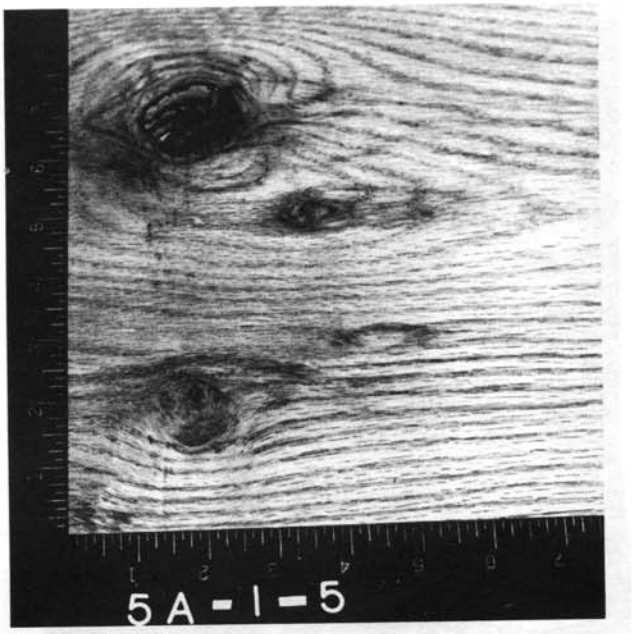
Depth—4.5 inches



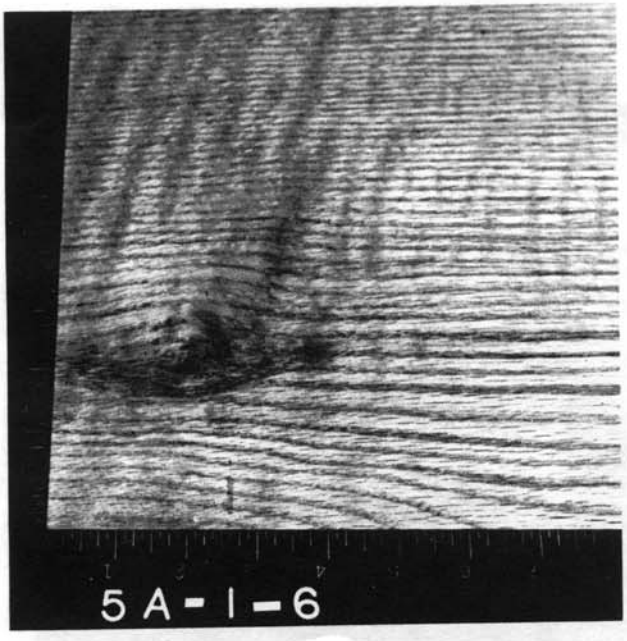
Depth—4.8 inches



Depth—5.5 inches

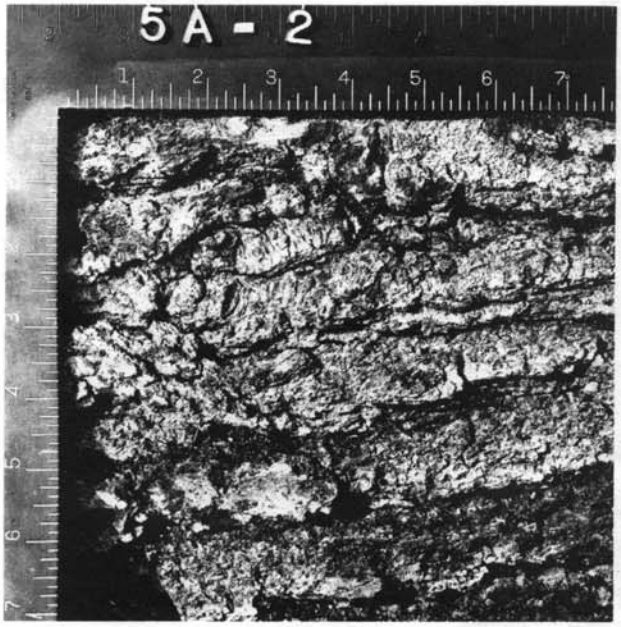


Depth—6.5 inches

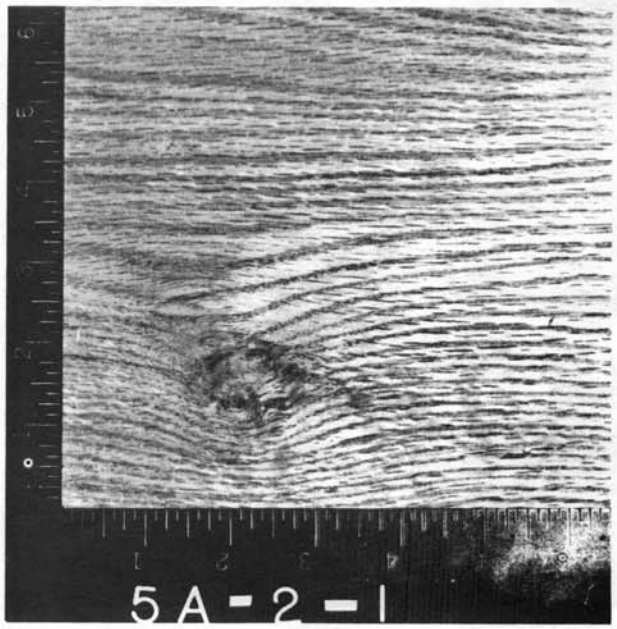


Depth—7.0 inches
Accumulative veneer thickness—7.8 inches

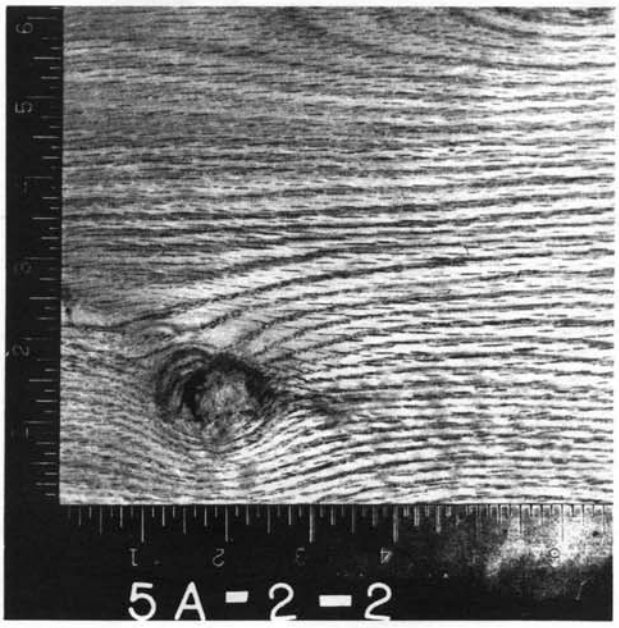
Figure 7.—Knot overgrowth (light distortion) and associated internal defects.



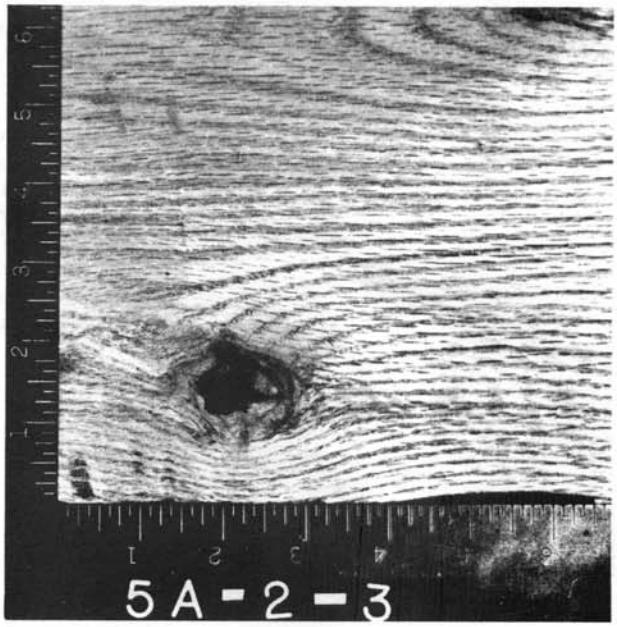
Defect size . . . . . 2 1/2 x 2 inches
Log diameter at defect . . . . . 22.5 inches
Flitch thickness at defect . . . . 10.1 inches
Log position . . . . . upper log



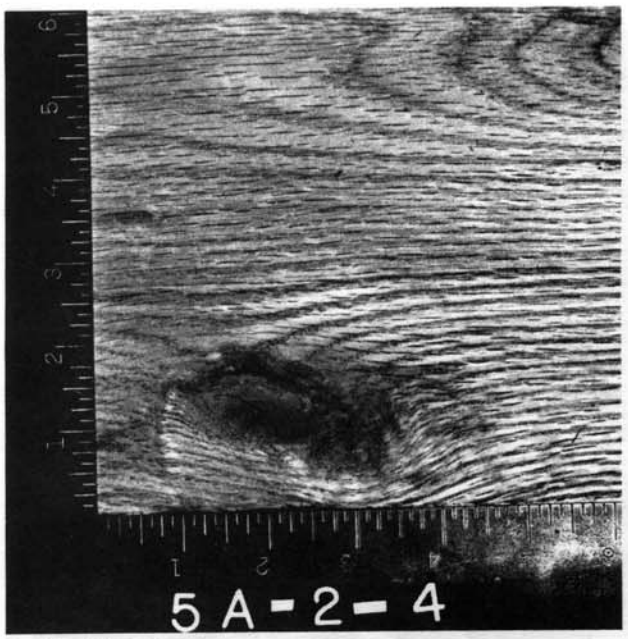
Depth—6.5 inches



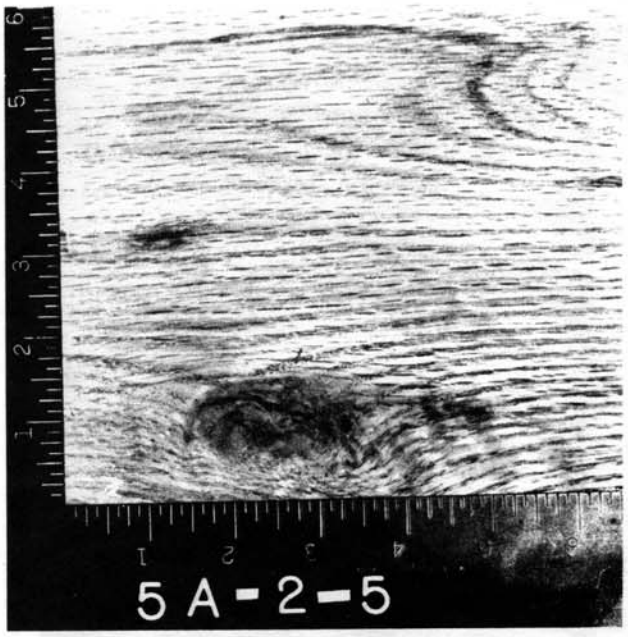
Depth—6.7 inches



Depth—7.0 inches



Depth—7.5 inches

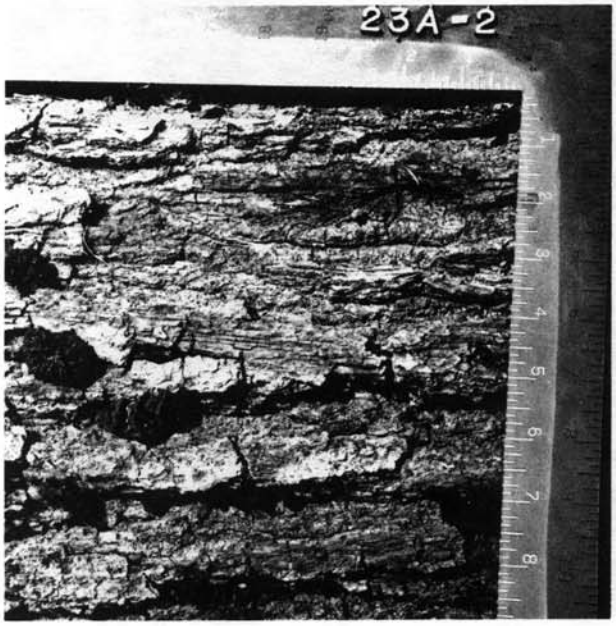


Depth—7.7 inches
Accumulative veneer thickness—7.7 inches

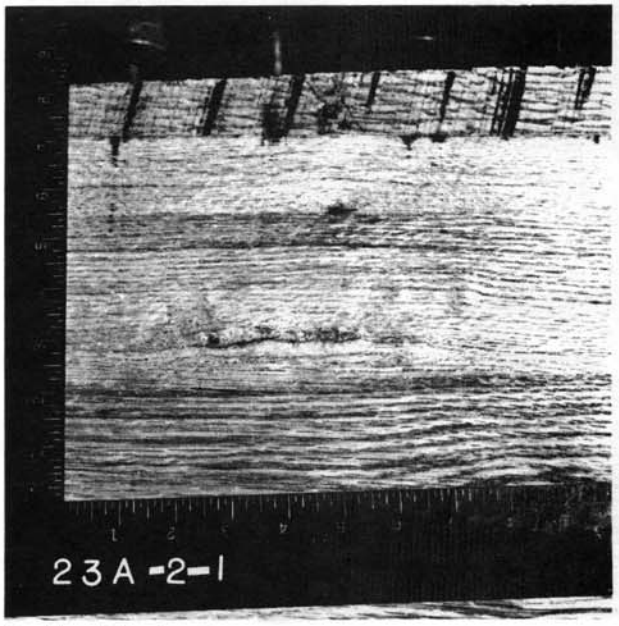
Overgrown Wounds

Two types of wounds that cause little or no grade defects are: new wounds (1 year old or less) that are slabbed off, and old, deeply buried wounds that healed over completely before deterioration began and are now located in the heart center. Figure 8 shows an old, overgrown sound wound with some ingrown bark. This defect is located in the heart center, which is defined as the central portion of the log with a radius equal to 20 percent of the total log diameter (Rast et al. 1973). In figure 8, the diameter of the log at the defect is 17.0 inches; therefore, the radius of the heart center is 3.4 inches. The backing board is 1.5 inches thick, and the distance to the last trace of the defect is 1.9 inches; therefore, the product defect is well within the defined heart center. Although there are 28 sheets of veneer containing this defect, the grade of these final sheets before the backing board normally is very low.

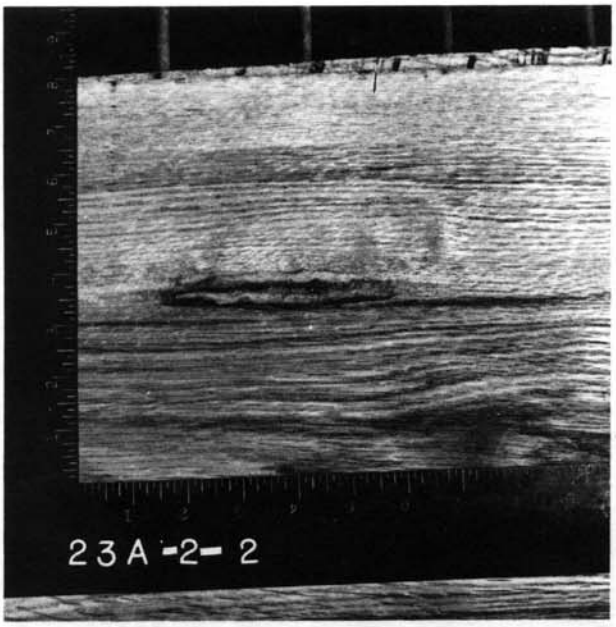
Figure 8.—Overgrown wound and associated internal defects.



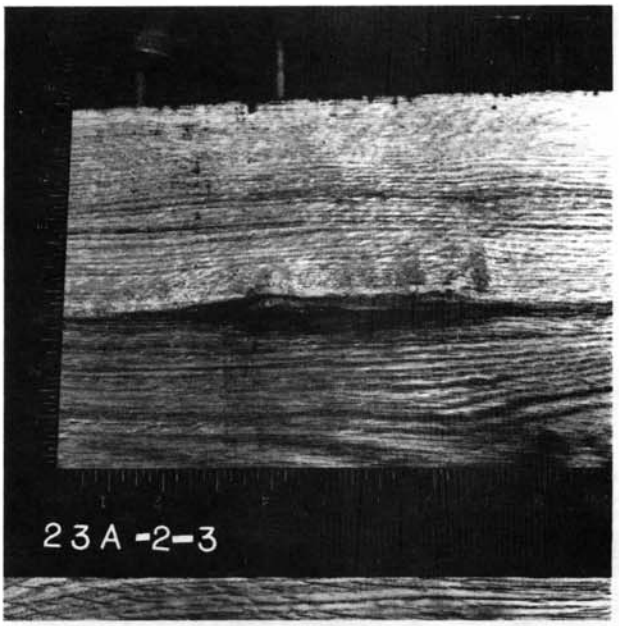
Defect size . . . . . 5 x 2 inches
Log diameter at defect . . . . . 17.0 inches
Flitch thickness at defect . . . . . 7.9 inches
Log position . . . . . upper log



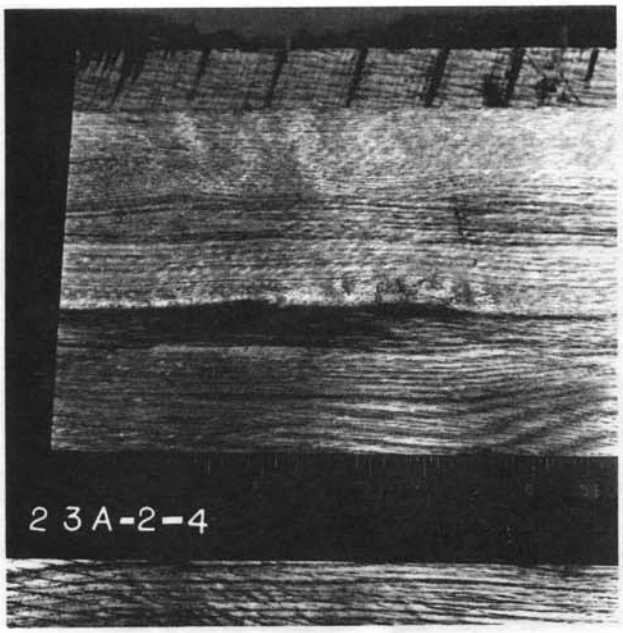
Depth—4.5 inches



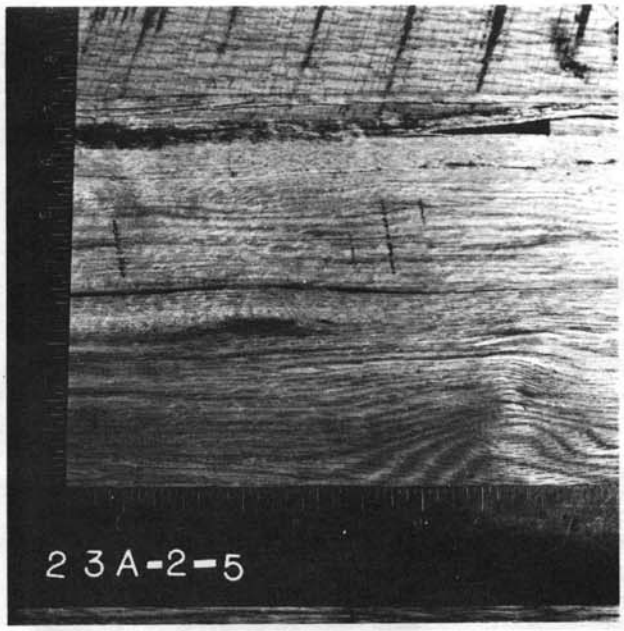
Depth—4.8 inches



Depth—5.0 inches



Depth—5.2 inches

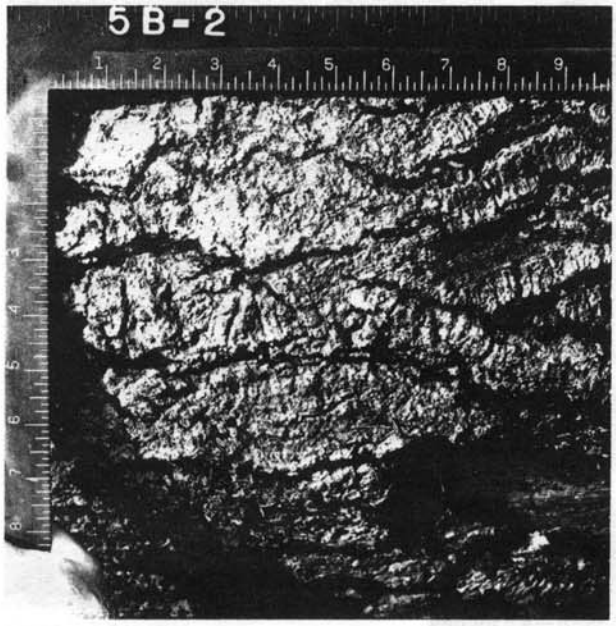


Depth—5.4 inches
Accumulative veneer thickness—5.4 inches

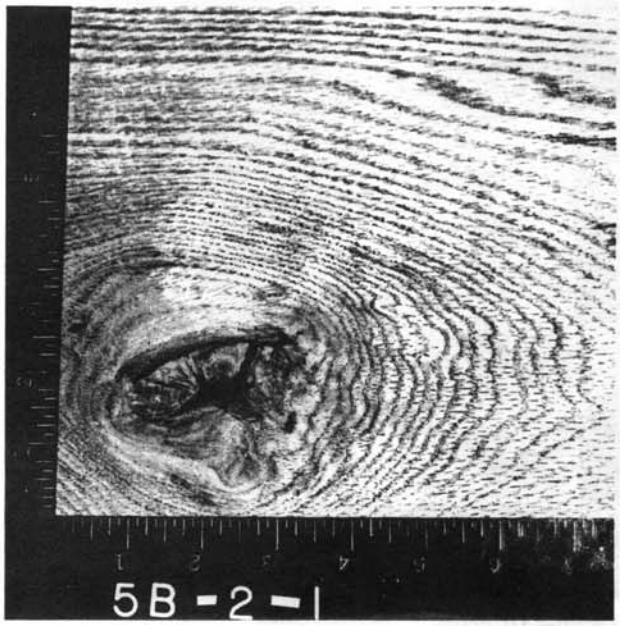
Bumps

Almost 90 percent of all bumps cover limb stubs, adventitious bud clusters, ingrown bark, or a combination of these and therefore, cause a product defect. Bumps are classified as high, medium, or low bumps according to their height to length ratio (Rast et al. 1973). The bump in figure 9 is a low bump. As seen in this figure, even low bumps contain defects very close to the log surface, with very little, if any, clear wood over it. Bumps are distinguished from overgrown knots by the absence of concentric circles and the relative smooth and regular bark pattern over the defect.

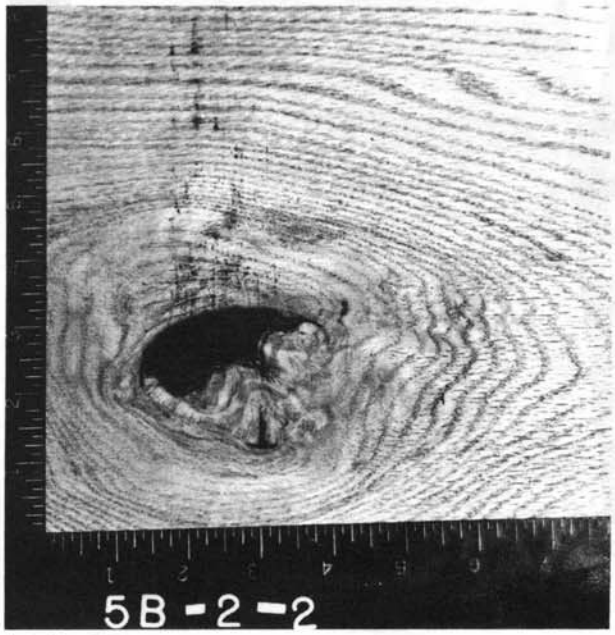
Figure 9.—Bump (low) and associated internal defects.



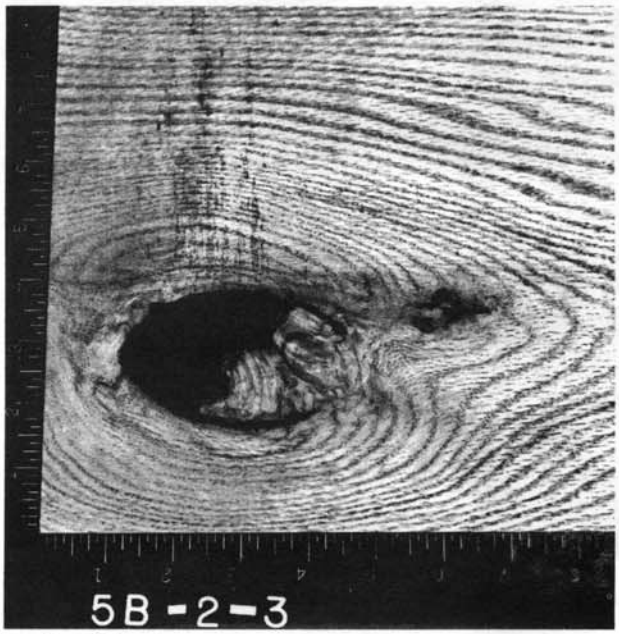
Defect size..... 4 x 4 x 1/2 inches
Log diameter at defect..... 23.6 inches
Flitch thickness at defect .... 10.1 inches
Log position ..... upper log



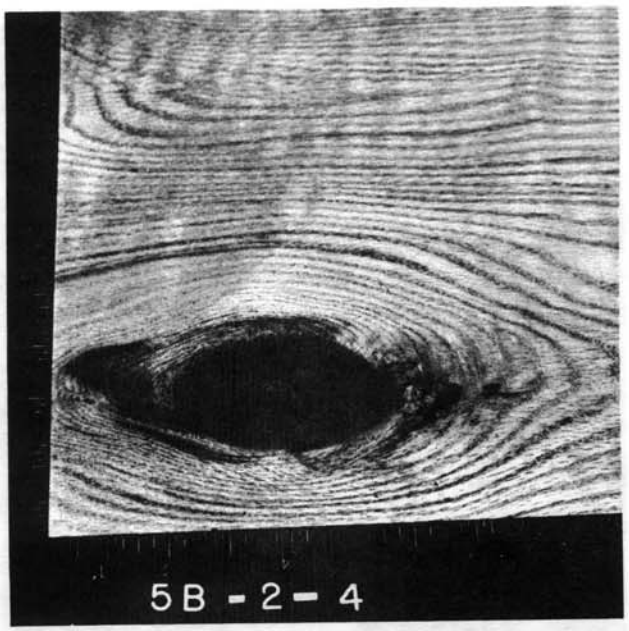
Depth—0.0 inch



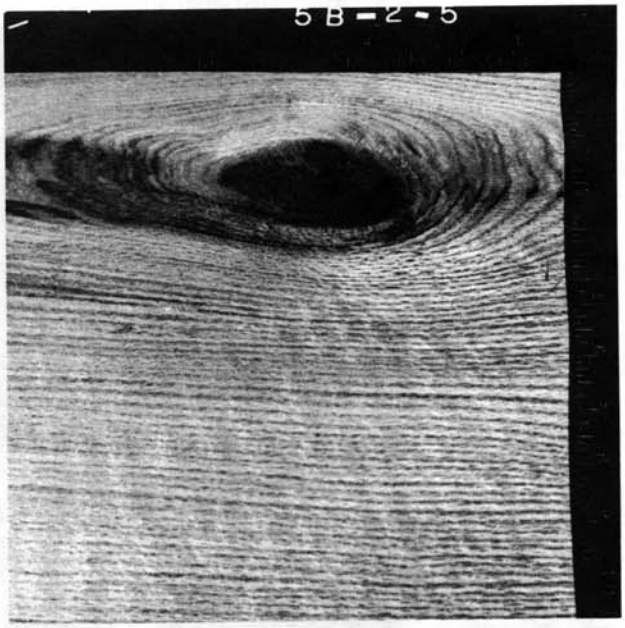
Depth—0.5 inch



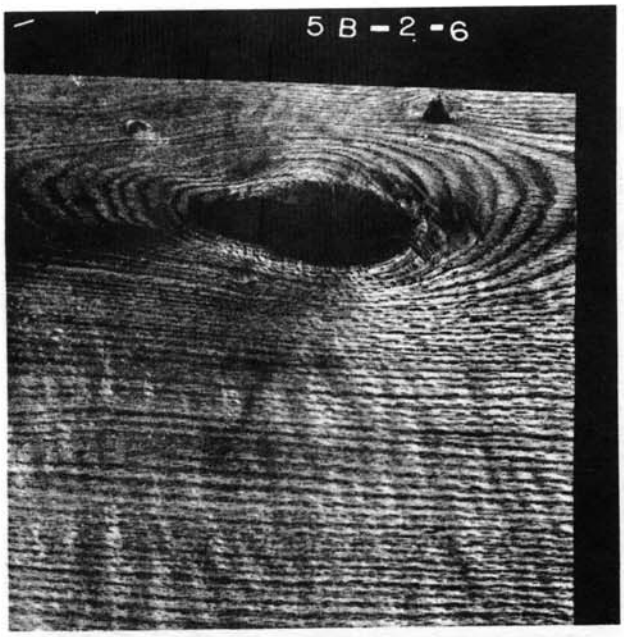
Depth—1.0 inch



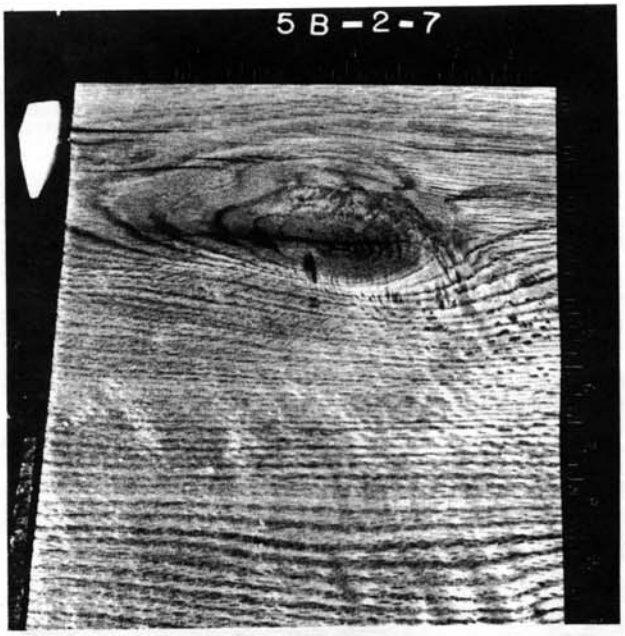
Depth—3.0 inches



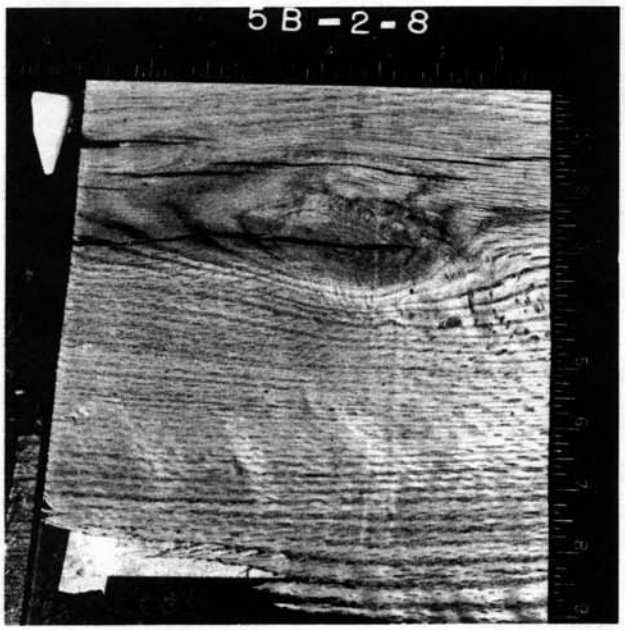
Depth—4.5 inches



Depth—5.5 inches

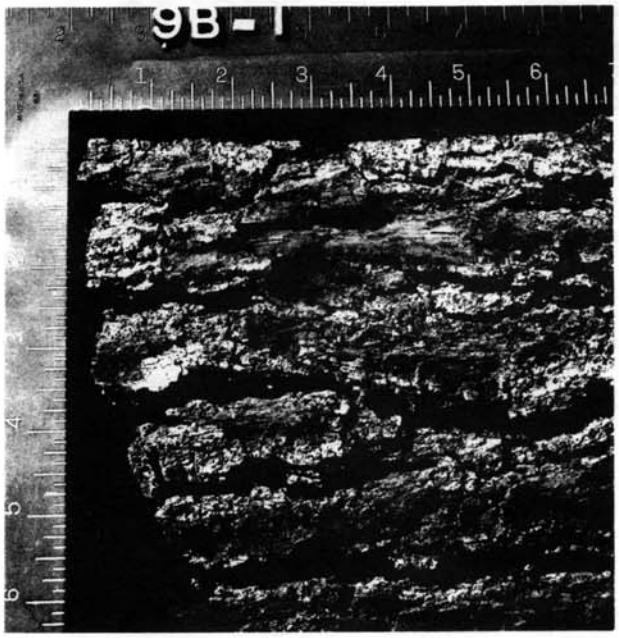


Depth—7.0 inches



Depth—7.3 inches
Accumulative veneer thickness—7.3 inches

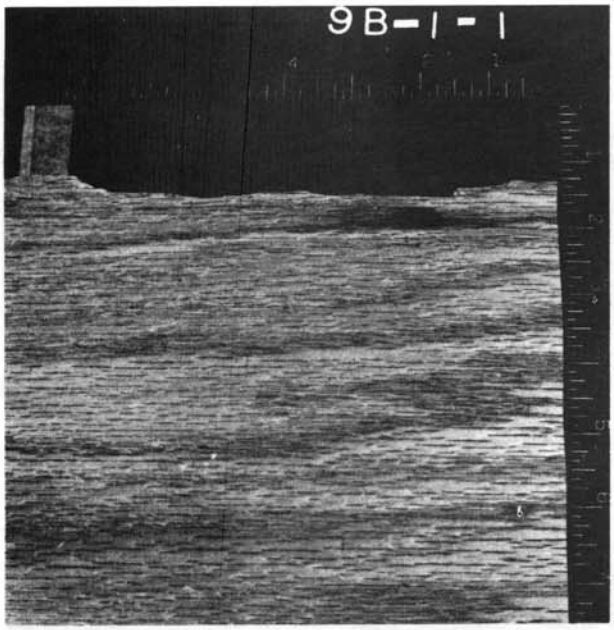
Figure 10.—Borer damage and associated internal defects.



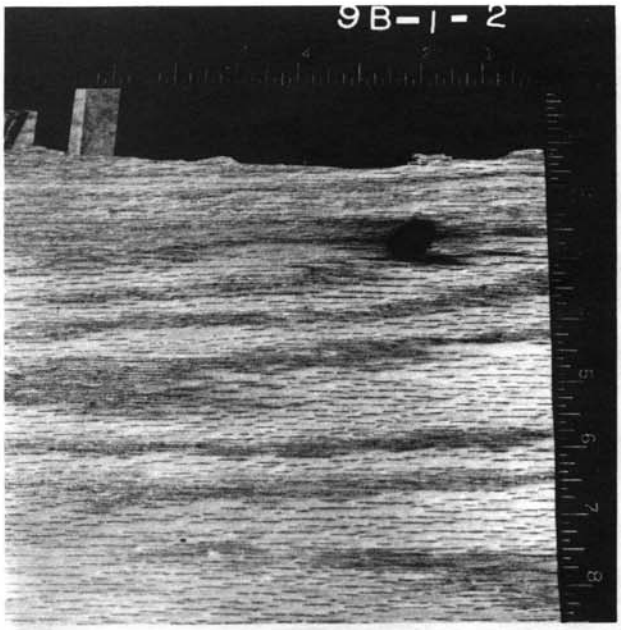
Defect size . . . . . 1/2 x 1/2 inch
Log diameter at defect . . . . . 21.4 inches
Flitch thickness at defect . . . . . 9.8 inches
Log position . . . . . butt log

Insect Borer Damage

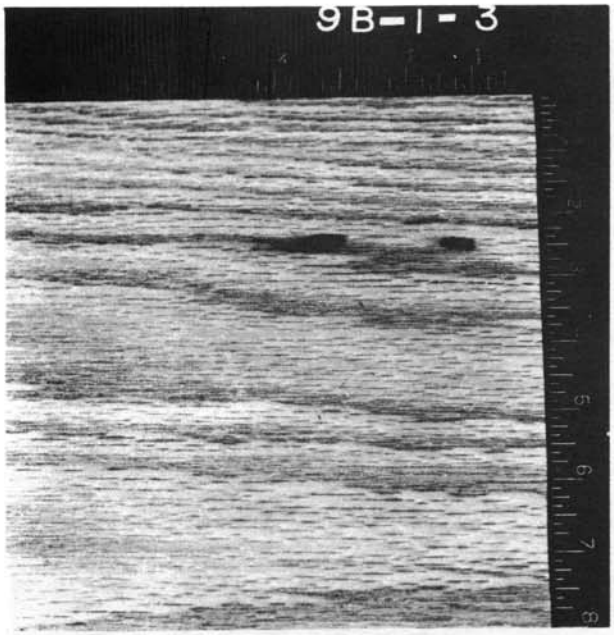
Insect borers cause considerable product damage depending on the severity, location, and timing of their attack. New, or relatively new, successful attacks (Fig. 10) are very damaging in face veneer. Older attacks confined to the heart center or a limited number of attacks in products where plugging is allowed are less damaging. Although the hole extends only 1.4 inches into the actual veneer in the example, it is very damaging because high-quality veneer is recovered near the outside of the log.



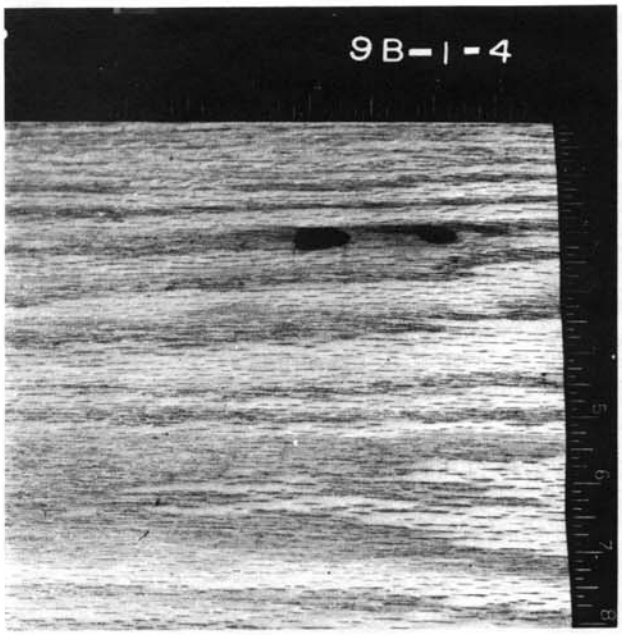
Depth—0.0 inch



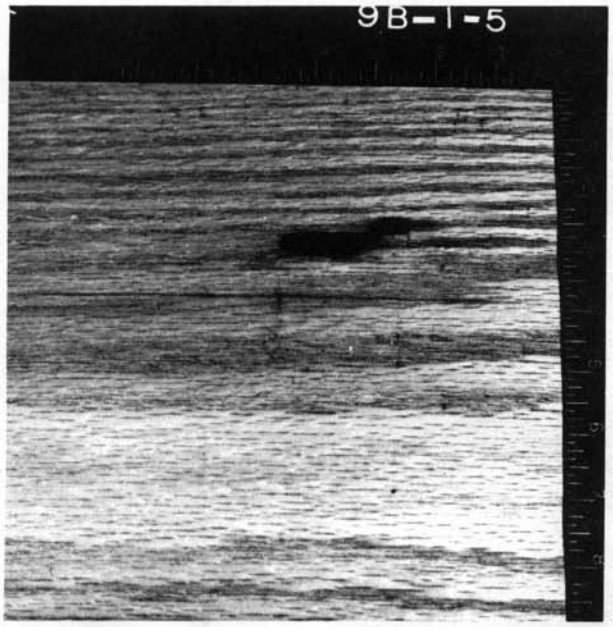
Depth—0.3 inch



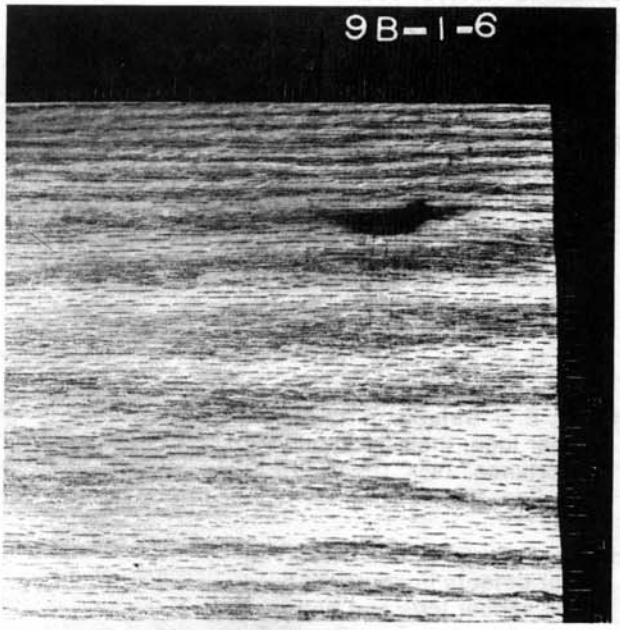
Depth—0.5 inch



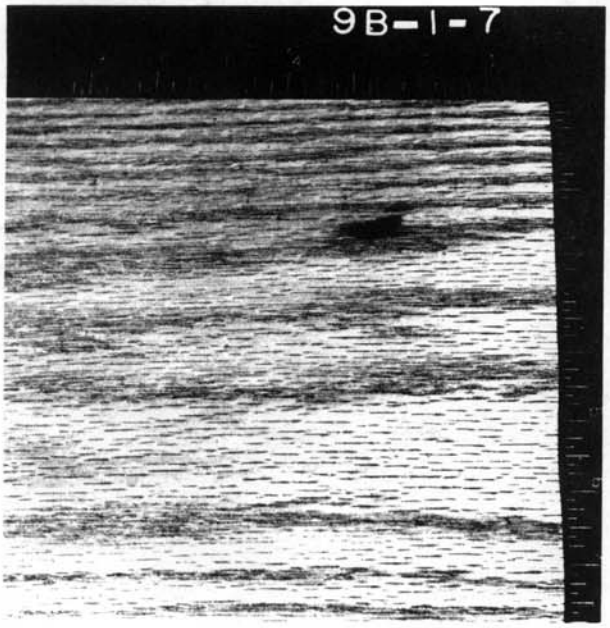
Depth—0.8 inch



Depth—1.0 inch



Depth—1.4 inches



Depth—1.4 inches
Accumulative veneer
thickness—5.8 inches

Selected References

Esau, Katherine **Anatomy of seed plants.** New York: John Wiley & Sons, Inc.; 1960. 376 p.

Frederick, Douglas J.; Koch, Christian B.; Carvell, Kenneth L. **The relationship between certain external characteristics and internal defect in black cherry**. Morgantown, WV: West Virginia University Agricultural and Forestry Experiment Station; 1973; Bull. 615. 15 p.

Harrar, E. S. **Defects in hardwood veneer logs: their frequency and importance.** 1954; USDA For. Serv. Res. Pap. SE-39. 45 p.

Harrar, E. S.; Campbell, R. A. **The major defects in southern hardwood veneer logs and bolts.** 1966; USDA For. Serv. Res. Pap. SE-19. 23 p.

Lockard, C. R.; Putnam, J. A.; Carpenter, R. D. **Grade defects in hardwood timber and logs.** U.S. Dep. Agric.; 1963; Agric. Handbk. No. 244. 39 p.

Lutz, John F. **Wood and log characteristics affecting veneer production.** 1971; USDA For. Serv. Res. Pap. FPL-150. 31 p.

Marden, Richard M; Stayton, Charles L. **Defect indicators in sugar maple—a photographic guide**. 1970; USDA For. Serv. Res. Pap. NC-37. 29 p.

Rast, Everette D.; Sonderman, David L.; Gammon, Glenn L. **A guide to hardwood log grading.** 1973; USDA For. Serv. Gen. Tech. Rep. NE-1. 32 p.

Stayton, Charles L.; Marden, Richard M.; Buchman, Roland G. **Exterior defect indicators and their associated interior defect in sugar maple.** For. Prod. J. 20(2):55-58; 1970.

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Rast. Everette D. **Photographic guide of selected external defect indicators and associated internal defects in northern red oak.** Broomall, PA: Northeast. For. Exp. Stn.; 1982; USDA For. Serv. Res. Pap. NE-511. 20 p.

To properly classify or grade logs or trees, one must be able to correctly identify defect indicators and assess the effect of the underlying defect on possible end products. This guide aids the individual in identifying the surface defect indicator and also shows the progressive stages of the defect throughout its development. It illustrates and describes eight types of external defect indicators and associated defects that are particularly difficult to evaluate.

Keywords: Defect identification; photo guide; northern red oak; quality assessment.

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